

**Reports on small-scale research projects by class members
in Engineering Physics 2 (PHY 182), Spring 2010**

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We have an inexpensive cafeteria!

I wanted to discover whether it was more efficient (with regards to cost and time) to buy lunch at the Broome Community College cafeteria, or to buy groceries and pack a lunch. I chose to test for the same quality of food, recreating the same meals that one could buy at the cafeteria with similar quality of ingredients. The BCC cafeteria is located in the student center on campus. Within it there are three vendors, Nirchi’s, Subway, and the Matruski Café. I began by asking each business in the BCC cafeteria which meals were most popular among students. Then over a period of one school week, I purchased each of these meals between 11:00 and 11:30 am, and kept track of the cost and time spent in line. The time spent in line was quantified as a cost at \$7.25/ hour. The results were as follows:

	Subway	Nirchi's₁	Nirchi's₂	Matruski Café₁	Matruski Café₂
Most common Meal	Turkey Sub and soda	Cheese Pizza and Soda	Chicken Barbeque Pizza and Soda	Chicken Tenders and Soda	Chicken Wrap and Soda
What's included	Turkey, Italian Bread, Lettuce, Tomato, Mayonnaise, Provolone Cheese, 16 oz soda	Four Slices Pizza (dough, tomato sauce, cheese), 16 oz soda	Four Slices Pizza (dough, white garlic, barbeque sauce, chicken)	breaded chicken tenders, 16 oz soda	Tortilla, mayonnaise, chicken, lettuce, tomato, 16 oz soda
Cost of Meal	\$5.82	\$4.45	\$5.15	\$6.35	\$4.99
Time In line	11 minutes	5 minutes	6 minutes	6 minutes	9 minutes
Time Cost	\$1.33	\$0.60	\$0.73	\$0.73	\$1.09
Total Cost	\$7.15	\$5.05	\$5.88	\$7.08	\$6.08
Total for the week					\$31.24

Deli Sliced Turkey	\$1.99
Foot long Italian Bread	\$2.25
Package of Lettuce	\$2.50
tomatoes	\$1.48
Mayonnaise	\$2.69
Provolone Cheese	\$2.49
Frozen Dough	\$2.19
Tomato Sauce	\$1.49
Pizza Blend Cheese	\$1.99
Barbeque sauce	\$1.99
Chicken Breast	\$1.99
Frozen Chicken Tenders	\$3.99
Tortillas	\$2.69
6 pack 16 oz soda	\$2.75
TOTAL	\$35.48

The next week, on Sunday night I got groceries from

Meal	Time to prepare	Time cost
Turkey Sub	5 min	\$.60
Cheese Pizza	20 min	\$2.42
BBQ pizza	30 min	\$3.62
Chicken tenders	10 min	\$1.21
Chicken Wrap	5 min	\$0.60
Grocery store	45 min	\$5.43

Wegman's to make all of the meals I had purchased in the first trial. I will assume that the student already owns basic items such as butter and salt and pepper. By adding the time cost to the food cost, as tabulated, the total cost for buying groceries is **\$49.36**. This is nearly twenty dollars more expensive than buying from the school. However, after the second trial was

done I realized that I almost had enough food left over for another week of meals. The only things that would require repurchasing were bread, chicken breast and soda. By doing some calculations I estimated the total cost of groceries for two weeks, and then compare that to the total cost of eating at the school for two weeks.

The cost at the school would be the same for the second week, because you are buying per unit. So the estimated cost for two weeks would be 31.24×2 , or **\$62.48**. For the second trial, the time to make each meal would remain the same, \$8.48. The time to go to the grocery store would be significantly shorter, as you are only picking up a few necessities. I will estimate 25 minutes (\$3.02). The only food cost would be the cost of bread, chicken breast and soda. This totals \$6.99. The total cost for

the second week is only **\$18.48**. By adding this to the cost of the first week we get a total of **\$67.84**. This cost is still higher than that of buying food at the cafeteria.

This experiment has a large uncertainty because there are so many variables such as where you shop, what you purchase, in bulk or per unit, etc. This experiment does, however, provide reasonable evidence that on a week to week basis, it is more efficient to buy lunch at the BCC school cafeteria.

–A.G.

Cold water freezes faster than hot water.

To answer the question of whether hot water freezes faster than cold water, an experiment was conducted using two identical plastic ice trays and a freezer. One tray was filled with water from a faucet in the cold position and the other filled with water from a faucet in the hot position. The trays were then placed on opposite sides of a frost free freezer set on medium. The trays were checked every half hour for progress and the ice was considered to be completely frozen once the cubes could be removed and, when broken open, no liquid remained on the inside.

It seems logical that the tray of cold water would freeze sooner than the tray of hot water, as it is much closer to the freezing temperature of 0°C than its counterpart, but this may not always be the case. In fact, there is a phenomenon thought to exist, known as the Mpemba Effect, describing hot water as freezing faster than cold water. Here's a brief description of the factors that play into the freezing time of ice. A good place to start is by defining heat. Heat is the transfer of energy driven by temperature difference. There are four separate factors that affect how ice freezes: conduction, convection, evaporation, and radiation. Through conduction, heat is transferred from one media to another. Heat flow always occurs from the hotter medium to the cooler one. In the case of this experiment, this happens in two ways. First, the ice tray itself is resting on the cooler freezer shelf. Heat from the tray flows to the shelf, cooling it, and as a result, heat from the water flows through the tray and to the shelf, cooling the water. Second, the water is also directly in contact with the cooler air. Heat flow occurs from the warmer water to the cooler air, further cooling the water. Convection is an effect that occurs due to differences in water densities. As water cools, it becomes denser, and sinks to the bottom; this in turn forces the less dense warmer water to the top. As the water cools below 4°C , it becomes less dense and again rises to the top. This continuous motion creates what is known as a convection current. Freezing is also affected through evaporation. As the water evaporates, it cools. It also loses mass. Since hot water evaporates more than cold water, than it should have less mass. With less mass to be turned to ice, perhaps the freezing time could be shorter. The final factor that could play into the freezing time for water is radiation. It is indeed possible for the hot water to radiate off some of its heat. However, it is likely that the effects due to radiation are quite small.

The two trays were placed in a freezer and the time was noted. An alarm was set for every half hour as a reminder to check on the freezing progress. After the first half hour, a layer of ice had already formed on top of the cold water tray. The hot water tray remained almost completely unfrozen. After

the first hour had passed, it was observed that the top layer of both trays was frozen. However, by puncturing a cube in each tray, it was noticed that the ice was thicker in the cold water tray. After an hour and a half had passed, the cold tray was almost completely frozen through and there was a noticeable change in the color of the ice. Upon observing the hot water tray, water was still easily noticed through the ice. After two hours had passed, the ice in the cold tray was observed to be completely frozen while the ice from the hot water tray appeared to still have water present on the inside. To reach a definitive answer, an ice cube from each tray was removed and punctured. The ice cube from the cold water tray was observed to be completely solid, while the ice cube from the hot water tray still spilled some water from its inside after being punctured. The experiment was repeated two separate times for a total of three trials to ensure the results. Each trial had a similar outcome and the data is chronicled in Table I below. Given the results upon the completion of this experiment, it is fair to conclude that cold water will freeze before hot water under the given conditions. However, this is not to say that the converse is never true. The Mpemba Effect is highly variable and may only happen under certain conditions that may not have been present during this experiment. Such differences could be the temperature ranges for the water (perhaps this phenomenon only holds true for a certain temperature range of hot water), or the type of container and whether or not it is open or closed (different effects on conduction and evaporation).

Table I

Time	Cold Water Tray	Hot Water Tray
Half Hour	Layer of ice on top	Still almost completely unfrozen
One Hour	Top layer frozen, thicker ice	Top layer frozen, thinner ice
One and a Half Hours	Almost completely frozen, noticeable change in color of ice	Frozen, but still noticeable amount of water on inside
Two Hours	Completely frozen, proved by puncturing	Not frozen through, proved by puncturing

–A.G.

Verification of the Caloric Content of a Selected Fiber Supplement

An Experiment Conducted by J.O. Under the Supervision of Dr. Daniel Brennan

Abstract:

We precisely measured the caloric content of the fiber supplement *Fiber Therapy Hydrophilic Mucilloid*, showing it to agree with the less precise value quoted by the manufacturer.

Introduction:

The company Accumed Inc., based in Lawrenceville, NJ, manufactures this fiber supplement with the intent of providing consumers with a rich source of fiber to relieve gastrointestinal symptoms such as constipation, at a cost of few calories. This experiment is not an evaluation of the effectiveness of *Fiber Therapy* in providing the advertised amount of fiber, but it is rather one that measures the number of calories per serving as advertised by the company. We used a device known as a bomb calorimeter, which measures the change in temperature of a known mass of water to find the amount of energy released from the combustion of the sample. The amount of thermal energy released from the sample is equal to the amount of chemical energy contained in a sample, which conventionally measured in calories. The number of calories that one should consume within a period of time depends on activity, as those who are more active need more energy and therefore more calories.

The Theory:

Work, can be defined as a force times a distance or as a pressure times a change in volume. When combusting a fuel such a gasoline in an engine, the potential energy in the bonds of the octane molecules, etc., is released and rapidly heats the gases in a cylinder that does work on a piston because they provide a force over the distance that the piston travels. If, however, the piston is jammed, then there is no work done, and the only place that the energy can go is into the material from which the cylinder is made, raising its internal energy and consequently its temperature. The bomb calorimeter is designed to be a chamber that allows absolutely no work by being clamped such that its volume does not change as a pressure is applied to it. Therefore since none of the energy released from the combustion of the sample is used to do work, it follows that it is all converted into internal energy. Since the change in internal energy of a sample is directly proportional to the change in temperature (in Kelvin), scientists can objectively measure the change in temperature and compute the change in internal energy knowing the constants unique to the material whose temperature is changing. The following proportionalities allow one to more easily picture the relationships described above. Note that Q is the internal energy, n is the number of moles, and T is the temperature, in Kelvin.

$$\Delta Q \propto n$$

$$\Delta Q \propto \Delta T$$

Therefore, it follows that:

$$\Delta Q \propto n\Delta T$$

This proportionality is not too useful in and of itself, but it can become an equation as long as one can provide a constant in order to make it true.

$$\Delta Q = nc\Delta T$$

The letter c , in this case, does not stand for the speed of light but it rather is the molar heat capacity of a substance.

Since all bomb calorimeters have a constant number of moles of a substance being heated (the number of moles does not change during the testing process), and a constant molar heat capacity, the following equation can be written:

$$\Delta Q = C_{\text{cal}} \Delta T$$

The bomb calorimeter that we used in the laboratory was very sophisticated, and it requested the mass of the sample so that it could give us the results in Joules per gram. Joules, by definition, are a measure of energy, so that means that the machine already calculated the energy, knowing its own Calorimeter constant and measuring the change in temperature. We would have preferred to run the experiment multiple times, but we did not have that luxury because the machine decided not to cooperate the second time that we tried to run the experiment. The chart below shows the data that we were able to collect:

Trial	Mass of Fiber Therapy Supplement (g)	Heat of the Combustion (J/g)
1	.5008	16489
2	.5299	Not measured

Fortunately, one trial was a success, though we had to resort to other means to estimate the experimental uncertainty. Dr. Harold Trimm, the keeper of the apparatus, assured us that in his combustion of benzoic acid, a substance with a known heat of combustion, he found the specific heat of the calorimeter in three trials, each of which was within .1% of all other specific heats. Thus, it is reasonable to suppose that the results reported by the calorimeter for the heat of combustion of the *Fiber Therapy* supplement are accurate within $\pm .1\%$. The next step is to convert the units of potential energy in the fiber supplement to more familiar ones that can be recognized and compared to the units given by the company.

The company gave the number of Calories per serving to be 45. It is important to remember when considering the energy content of foods that the Calories that are advertised are actually kilocalories, namely, 1000 times the amount of energy in just a calorie. The number of grams in a serving, according to the manufacturer, is 12. This means that there are, on average, 3.75 Calories per gram. Due to the presence of only two significant figures on the label to *Fiber Therapy*, we can suppose that it actually means $45 \pm .5 \text{ Calories}$ and $12 \pm .5 \text{ grams}$. The first has an experimental uncertainty of 1.1%, and the second has an uncertainty of 4.2%. Adding them together, as correct practice would have us do if they are independent of each other, brings the total uncertainty up to 5.3%, including the .1% from the uncertainty of the instrument. Now, it is necessary to see if the company was, in fact, within the range of uncertainty.

In doing this it is necessary to establish some ratios relevant to the units of the respective energy contents of the fiber supplement:

1 kilocalorie or Calorie for energy content of foods = 1000 calories

$$1 \text{ calorie} = 4.184 \text{ Joules}$$

Therefore, it follows that the company advertised:

$$\frac{3.75 \text{ Calories}}{\text{gram}} \left[\frac{1000 \text{ calories}}{\text{Calorie}} \right] \left[\frac{4.184 \text{ Joules}}{1 \text{ calorie}} \right]$$

The units for the Calories and calories cancel, leaving the result in Joules per gram:

$$\frac{15690 \text{ Joules}}{\text{gram}}$$

We measured the energy content per gram of *Fiber Therapy* to be:

$$\frac{16489 \text{ Joules}}{\text{gram}}$$

Finding the percent difference between the two yields:

$$\text{Percent Difference} = \frac{100 | \text{Experimental Value} - \text{Accepted Value} |}{\text{Accepted Value}}$$

$$\text{Percent Difference} = \frac{100 | 16489 \text{ J/g} - 15690 \text{ J/g} |}{16489 \text{ J/g}}$$

$$\text{Percent Difference} \approx 4.8\%$$

Our data for one sample has far better precision than we attribute to the manufacturer's value for the material produced in bulk. A consumer might assume that the Caloric content is exactly as specified by Accumed Inc., so it would be better if their *Fiber Therapy* supplement had, if anything, fewer Calories than listed on the label. Still, the company is doing a reasonable job in reporting the energy content of their product, because 4.8% is less than 5.3%.

Does Short Napping make you Smarter and Healthier?

In my study of whether taking short naps can make you smarter and healthier, I took a thirty-minute afternoon nap every day for a one week. Before the nap, I measured my blood pressure with a blood pressure monitor and tried to solve an “Unblock” puzzle game on my cell phone. I measured the time required to finish the puzzle. After the nap, I again measured my blood pressure and finishing time for the puzzle. I recorded both of these data.

Data								
Date	Before the Nap				After the Nap			
	Puzzle Timing Seconds	Blood Pressure			Puzzle Timing Seconds	Blood Pressure		
		Systolic mm HG	Diastolic Mm HG	Heart Pulse rate		Systolic Mm HG	Diastolic Mm HG	Heart Pulse rate
4/4/2010	1.01	125	95	90	0.360	120	90	89
4/5/2010	0.90	135	99	85	0.870	125	95	83
4/6/2010	1.19	127	85	95	0.620	123	83	90
4/7/2010	1.04	121	92	84	0.730	115	89	83
4/8/2010	1.26	115	97	86	0.450	111	95	82
4/9/2010	1.23	132	90	97	0.550	125	88	95
4/10/2010	1.35	125	94	94	0.600	119	81	93
Average	1.14	126	93	90	0.597	120	89	88

My research data suggest that the short nap made me smarter and healthier. Napping can refresh and boost the capacity of the brain. It helps to learn new things. Napping for an hour can boost brain power and make you smarter. The results of my study showing that I did better on puzzle solving after the nap. Before the nap my average puzzle solving time was 1.14 second. After the nap my averages puzzle solving time was 0.597 seconds, showing improvement in solving skill after the nap. After working long hours many people smoke or drink caffeine for refreshment, but napping during the day is just as effective. Napping can also improve our memory, cognitive function and mood. During busy working hours our brain engages in many activities, and after some point our thinking process gets weaker. Our brain is less able to learn new information when we stay awake a longer time. Sometimes we are trying to remember something which we forgot, as some people have trouble remembering simple things such as faces, names, telephone numbers and passwords. During the nap our brain is able to refresh its

short term memory of information which we learned during the day. We can more easily recover those memories while we are relaxing. Napping makes our brain relax and also makes memories stronger and helps to recover old memory fast. My study suggests that after the nap I had lower levels of stress, as indicated by my blood pressure being lower than before the nap. Before the nap, my average Systolic blood pressure was 126 mm HG and average diastolic blood pressure was 93 mm HG. After the nap, my average systolic blood pressure was reduced to 120 mm HG and average diastolic blood pressure was 89 mm HG. Naps help to keep our hypertension level down which helps to keep our blood pressure stable. If we have continuous hypertension; it is a sign of higher risk of cardiovascular disease. Naps also improve our attitude and psychological reactions. It is necessary to eat healthy food, get a good night's sleep, and physical and mentally exercise to keep a healthy body, and it is also desirable to take a nap to relax our mind and body.

–C.P.

An “energy-saving” tip that didn’t work: Cleaning out under the refrigerator

Energy consumption of a 22-cubic-foot Kenmore refrigerator manufactured in 1994 stayed constant within 2% when the very dusty condenser coils were cleaned.

I measured the electric energy input to my kitchen refrigerator before and after cleaning the coil under the appliance. The manufacturer and the electric company advise cleaning the condenser coil every few months so that the refrigerator can function efficiently.

Here is a description of how a simple electric refrigerator works. A fluid like freon circulates in a closed loop. When the refrigerator is “running,” it is taking in electric energy as its compressor raises the temperature of the fluid above room temperature and pushes it through a heat exchanger, a winding tube underneath or behind the refrigerator. In this warm “condenser coil” the fluid is supposed to cool nearly to room temperature as it gives heat to the air outside. Next, the fluid goes through a throttle valve, a nozzle where its pressure drops so that each parcel of fluid suddenly expands and drops in temperature. The cold fluid goes through a second heat exchanger, in the wall of the freezing compartment or just behind it. Here the cold fluid warms as heat is transferred into it from the frozen foods. The freezing compartment in turn can cool off the main compartment of the refrigerator. The fluid has completed its circuit and reenters the compressor.

In fewer words, we can say that the refrigerator is a heat pump using electric energy input to make heat flow out of the cold interior and into the warmer air outside. For efficient functioning, the walls of the refrigerator need to be well insulated, but both the warm heat exchanger and the cold heat exchanger should have no insulation. Ice tends to accumulate on the cold coil at the freezing compartment. In a less expensive model, the householder needs to defrost the freezer periodically by putting the freezer contents into a picnic box and melting off the ice. A frost-free or automatic-defrost

refrigerator has the cold coil in a smaller chamber next to the freezing compartment. Circulating air cools the freezer whenever the refrigerator is running. A timer or frost sensor periodically blocks air flow between the cold coil and the freezing compartment; then an extra electric heater quickly warms the metal of the “cold” coil so that the built-up ice melts and drains away.

Airborne dust accumulates on the warm heat exchanger behind or below the refrigerator. The dust tends to impede heat flow between the warm fluid and the surrounding air. If the circulating warm fluid does not cool off as much as it should, the refrigerator will cycle on more often and use more electric energy, so your electric bill is higher.

I used a “Watts up? Pro” kilowatt-hour meter to measure energy use before and after cleaning the coil, which was originally covered with several millimeters of dust, accumulated over a year or more. I plugged the meter into the wall and plugged into it the standard-size, sixteen-year-old Kenmore refrigerator with top freezer. I wrote down the meter reading a few times each day for seven days before cleaning the coil and for six days afterward, in a data table with these columns:

Day	Time	Energy used, kWh
Friday Mar 26	10 PM	0
Saturday 27	7 AM	0.852
	12 noon	1.198
	10 PM	2.12
Sunday 28	9 AM	2.90
	6 PM	3.62
	10 PM	4.22 ... and so on.

By subtraction I computed thirteen values for the daily energy use. The values for March 26-27 and for March 27-28 are 2.12 kWh and $4.22 - 2.12 = 2.10$ kWh, respectively. When I did not have a reading at 10 PM on a particular day, I interpolated the reading from the next earlier and later data points.

From the set of values for daily energy use before cleaning I found the average as 1.97 kWh/d and the deviation of each value from the average. The greatest deviation was 9% of the average. I think the scatter was caused by day-to-day differences in opening the refrigerator door, by putting in bagfuls of groceries, and by scale-limited error in the energy meter—after passing 20 kWh, it could determine daily use only with an uncertainty of ± 0.1 kWh. I averaged the absolute values of the deviations to write the energy use as (1.97 ± 0.11) kWh/d = 1.97 kWh/d $\pm 6\%$. The average power input is $1970 \text{ W}\cdot\text{h}/24 \text{ h} = 82 \text{ W} \pm 6\%$.

In checking that the meter was working I noticed that the refrigerator power was usually about 10 watts, jumping to 90 W when the door is open, and jumping to 200 W when the compressor was running. I think the refrigerator was not in defrost mode for any significant time interval during the thirteen days, because the highest single daily-use value was greater than the average by only 7%. With the assumption that the door is open for a time negligible compared to 24 hours, I can approximately find the refrigerator’s duty cycle (the fraction f of the time for which the compressor is running) from $f(200 \text{ W}) + (1 - f)10 \text{ W} = 82 \text{ W}$ as $f = 0.38$.

After the seven-day measurement of baseline energy input, I used a vacuum cleaner with dusting brush and crevice tool, together with two radiator brushes, to clean the heat exchanger under the

refrigerator. I spent thirty minutes removing all of the visible fuzzy coating of dust from a couple of meters of winding tubing, but the mass of the dust accumulated in the cleaner basket was only 9 g. Evidently the dust coating was very porous. Then I continued the measurements of cumulative energy use for six days after cleaning. With again a computed average and average deviation, I wrote the daily energy use as (2.01 ± 0.11) kWh/d. The difference between the best values of 1.97 and 2.01 kWh, before and after cleaning, is not significant, because it is so small compared to the estimated uncertainty of ± 0.11 kWh. That is, there is no evidence that energy use increased when I cleaned the coils, and any decrease in energy use was too small to measure with this method. I imagine that the tube in the condenser was designed to be long enough for the refrigerating fluid to cool nearly to room temperature even when the tube is covered with a few grams of fluffy dust. I could reduce the statistically estimated uncertainty in the daily energy use by making “before” and “after” measurements for periods much longer than one week. But the ± 0.11 kWh/d daily scatter would still be present in longer-term measurements, so any computation of energy saving due to cleaning would be questionable. Because my values of 1.97 and 2.01 kWh differ by only 2%, I conclude that any energy saving is likely less than 2%.

The most probable overall value for my refrigerator’s daily energy use is 1.99 kWh/d. My electric bill shows the price I am paying for each kilowatthour is \$0.1057, so I calculate the annual energy use as 729 kWh, costing \$77. Along with my air conditioner, gas furnace, and gas stove, the refrigerator is one of the heavy hitters in household energy use; but gasoline for my car costs much more.

– R. M.

Frozen Pizza: store brand versus name brand

Abstract:

I tested whether the store brand Price Chopper frozen pizza was as good as the name-brand Tombstone Original frozen pizza. The taste test determined that my family preferred Tombstone Original pizza to Price Chopper pizza and that Tombstone Original pizza is worth the extra 90 cents.

Report:

Is store-brand frozen pizza as good as name-brand frozen pizza? The regular prices of the frozen pizzas at the time of the experiment were \$3.79 and \$4.69 for the Price Chopper pizza and the Tombstone Original pizza respectively.

Both pizzas were cooked at 400°F according to package directions. The pizzas were cooked together in the same oven. The Price Chopper pizza had a recommended cook time of 12-15 minutes and the Tombstone Original had a recommended cook time of 17-19 minutes.

I observed that the Price Chopper pizza was not thoroughly cooked at the minimum recommended time because the cheese was not completely melted and the crust was not cooked. Because of this, I decided not to compare minimal cook times. Instead, I changed my data sheet to refer both to the maximum

recommended cook time (for the slices my parents ate) and to the time it took to be golden brown (approximately four minutes past the recommended cook time, for the slices I ate).

I defined 5 categories for the taste comparison, for the three toppings: sausage, pepperoni and cheese, and also for the crust and the overall taste. I decided that overall taste would not be weighted differently than the other categories. I recorded my own results from the taste test and my parents' preferences. I found that the Price Chopper pizza had more pepperoni than the Tombstone Original. Because the pepperoni tasted very similar on both pizzas, I gave the Price Chopper pizza a higher score because it had a higher quantity. The Tombstone Original, however, had more cheese and sausage, and a thicker crust. My taste test rated these ingredients as tasting much better than those on the Price Chopper pizza.

My parents' results were similar to mine for the taste test. I observed that the results did not change drastically based on cook time.

The taste test was measured on a 1-5 scale. A score of 1 indicated that the Price Chopper pizza was much worse than the Tombstone Original; a 3 indicated that the two pizzas were about the same; and a 5 indicated that the Price Chopper pizza was much better. The category averages are as follows: the sausage had an average score of 1.67, the pepperoni an average score of 3.17, the cheese an average score of 1.33, the crust an average score of 1.00, and overall had an average score of 1.33.

Based on the results, I felt that the Tombstone Original pizza, although lacking some pepperoni, still tasted better in four out of five categories and about the same in the fifth. Therefore, I concluded that the Tombstone Original is better than the store-brand Price Chopper pizza, and worth the extra 90 cents.

Is Brand-Name Mozzarella Cheese Superior?

Store brand mozzarella cheese tastes as good as, or better than, the brand name competition I tested.

Mozzarella cheese is used in countless recipes including, most notably, pizza and lasagna. Heavy advertising causes most people to purchase name-brand food over the generic brand because of the "familiarity" the ads create. By surveying opinions on the best tasting mozzarella cheese without any ties to brand names, one would expect that brand-name cheese should be favored against generic cheese in a blind taste test. The generic cheese, *Great Value* (a Wal-Mart Product), was tested against brand name cheese manufacturers *Sargento* and *Kraft*. This experiment also indirectly illustrated how much food purchases are influenced by advertising.

Samples of cheese were cut into equally small pieces. Data was measured from 20 people between the ages of nine and eighty-five consisting ten men and ten women to provide a wide variety of measurements. The best tasting cheese was rated “3” followed by the next best cheese rated as “2” and worst cheese rated as “1”. For inconclusive opinions, the cheeses rated as tasting equally good were scored as “2”. For each brand, all the points assigned by different tasters were added, to represent which cheese was best based upon the high scores. If two brands of cheese were within three points of favorability, they were considered equally good. A three point difference represented a 2.5% difference (total point wise) based on an average of six points allotted for each individual over twenty individuals.

The *Great Value*, *Sargento*, and *Kraft* cheeses received ratings of 43, 42, and 35 points respectively. Thus, it can be determined the average opinion among people was that the *Great Value* was equally as tasty as *Sargento* cheese with only a 2.33% percent difference. On the other hand, *Kraft* cheese was rated noticeably lower than *Great Value* and *Sargento*.

Does your chewing gum lose its flavor?

Abstract

Through a controlled experiment I have tested how long the flavor of seven gums last. All of the testers in this experiment agreed on the longest and least longest lasting gum. The results showed that the longest lasting gum I tested, Trident Tropical Twist, lasts twice as long as the least long lasting, Juicy Fruit.

Data

Gum	Average from person(min)			Overall Average(min)
	1	2	3	
Stride Gum Spearmint	48.8	38.2	49	45.3
Trident Tropical Twist	63.2	52.2	59.8	58.4
Extra Spearmint	51	40.2	55.2	48.8
Orbit peppermint	40.4	31.4	42	37.9
Trident White Wintergreen	62.2	45.8	61.8	56.6
5 Gum Rain	63.2	49.2	59	57.1
Juicy Fruit	33.8	25.2	31.2	30.1

Results in order of flavor persistence

1. Trident Tropical Twist
2. 5 Gum Rain Flavor
3. Trident White Wintergreen
4. Extra Spearmint
5. Stride gum Spearmint
6. Orbit Peppermint
7. Juicy Fruit

Discussion

Many gum companies advertise their gum as having the longest lasting flavor. I have conducted an experiment to determine which of seven brands of gum lasts the longest. I tested various flavors of gum including different mints and fruit flavors, all with sticks of the same size. Two other people and I each chewed 5 pieces of each of the 7 gums, recording the clock time we start chewing and the time when the gum no longer had flavor. Each of us did our best to be consistent when deciding when the gum no longer had flavor. During the time that we were chewing we ate or drank nothing but water. That way it would not interfere with the flavor of our gum. Testers for this experiment varied in age and gender. Tester number 1 was a 19-year-old female (me), tester number 2 was a 43-year-old male and tester number 3 was an 87-year-old female. I then took the average of the chewing times for each gum and compared them. I concluded that Trident Tropical Twist, lasting on average 58.4 minutes, is the longest lasting out of the gums that I tested, whereas Juicy Fruit only lasted 30.1 minutes.

– B.L.

Price Difference and Daily Price Fluctuations of Airline Tickets to San Jose, CA

On May 14th I will be flying to San Jose, California, to visit a friend, and on May 23rd I will be returning to New York. I wanted to find out if airline prices fluctuate daily and if so, whether checking the prices daily would save me a significant amount of money. Also, I thought it beneficial to find out if one airline consistently has the lowest prices for these flights.

The experiment completed demonstrated the daily fluctuation of airline ticket prices and a percent variation between the highest and lowest prices for each airline. Also, the experiment demonstrated which airline has the cheapest average ticket prices for the chosen research time period and destinations.

The data and research were collected from one specific site, Orbitz.com. Two different destinations were researched during one time period. The destinations chosen were San Jose, California and San

Francisco, California. The trip will be from May 14th through May 23rd, so only Friday evening outgoing prices and Sunday returning prices were checked. The outgoing airport will be Rochester, New York. The flight options were limited because the flight leaving Rochester had to leave later in the evening, after 7:00pm. The airlines researched were Delta, US Airways and United Airways, because they seemed to be the cheapest airlines when I have used Orbitz.com in the past.

Each day, the prices of a roundtrip airline ticket from Rochester, NY, to both San Jose, CA and San Francisco were checked. The dates and prices of the tickets were tracked over a period of 7 days, from April 7th 2010 through April 13th 2010; the data is logged in the following table.

	4/7/10	4/8/10	4/9/10	4/10/10	4/11/10	4/12/10	4/13/10	Average	Percent Variation Between Highest & Lowest Prices
San Jose									
United Airways	\$383	\$383	\$388	\$386	\$385	\$385	\$385	\$385	1.29%
Delta	383	383	391	385	385	385	385	385	2.05%
US Airways	458	458	463	460	480	480	460	455	4.58%
San Francisco									
United Airways	\$340	\$340	\$373	\$375	\$403	\$403	\$365	\$371	15.6%
Delta	340	340	374	370	320	323	342	344	13.5%
US Airways	532	532	532	532	532	532	547	533	2.74%

	Average Percent Variation of Both Destinations
United Airways	8.44%
Delta	7.78%
US Airways	3.66%

From this research, the cheapest individual flight was logged on 4/11/2010 at \$320, traveling with Delta to San Francisco. Delta also had the cheapest average ticket price to both destinations; the average ticket price to San Jose was found to be \$385, and the average ticket price to San Francisco was found to be \$349.

United Airways had the same \$385 average ticket price to San Jose, which represents a tie for the cheapest average ticket price to San Jose. In general United Airways and Delta had similar pricings for

both destinations. There was a 0% difference in the average price to San Jose and a 5.9% difference in average price to San Francisco.

US Air had the most expensive average ticket price to both destinations; \$455 when flying to San Jose and \$533 when flying to San Francisco.

Delta and United Airways have cheaper average ticket prices when flying into San Francisco (\$385) as compared to San Jose (\$360). Since 2/3 of the airlines had lower average ticket prices when flying into San Francisco, I concluded that it is easier to find a lower priced flight to the San Francisco airport than to the San Jose airport.

The daily fluctuation of prices was also monitored. The percent variation between the highest and lowest ticket prices was calculated for each airline and for each destination. Then the average of the two percents variation was found for each airline.

The average percent variation for both destinations was 8.44% for United Airways and 7.78% for Delta. Once again, Delta and United Airways have similar outcomes and have a 7.82% difference in their average variations. US Airways has more consistent daily prices shown by its average variation of 3.66%. Knowing the percent variation is useful because it will allow me to recognize whether or not I should check prices for a period of time before buying, in order to find the lowest price. If the percent variation is high, I will generally be rewarded with greater savings if I check the daily prices of the United and Delta Airlines. Since the price ranges are greater for these airlines, it would be expected that I would find a less expensive ticket, if I checked the prices for multiple days. On the other hand, if I were going to buy a ticket from US Airways, the difference in prices will most likely be marginal; in this case I may not check the prices on multiple days considering the possibly savings is probably not worth the time spent.

With the information from this experiment, I plan to check the prices of the flights on a daily basis. I will check Delta and United Airways on Orbitz.com, because their fluctuation in prices is higher and on average their prices are lower than US Airways. My destination will be San Francisco, because repeatedly both Delta and United Airways have cheaper flights to San Francisco than to San Jose.

From the data and conclusions of this experiment, I anticipate that I will buy a flight that costs between \$320 and \$340, because I will continue checking the ticket prices until Delta or United Airways once again offers a ticket price within that range. -- R.C.

Is there a difference between Coke and Pepsi?

Seventy-six percent of twenty five people, in blind taste tests could not correctly name Pepsi versus Coke; but an even larger majority preferred the taste of Pepsi.

Watching commercials about blind taste tests between Coke and Pepsi always made me wonder: *Can people really taste the difference and correctly distinguish between the two?* So I

set up a little experiment of my own. I also added a generic version to see if there was a clear difference between any of the three.

I filled 3 cups with a mouthful of each brand, and placed them on a table in different arrangements so people couldn't tell the next person which was which. I had one person come in, take the sips and tell me which cup they thought was which brand, and which cup they thought tasted best. I used a table like the one below, with the "X" meaning they guessed that brand correctly.

Test	Best	Pepsi	Coke	Sam's
1	Sam's			
2	Pepsi	X	X	X
3	Coke			X

I had 25 people (including myself; by leaving the room and having a person set up as I did for them) perform this experiment. Several of the people were children. I personally thought I would be able to tell the difference between Coke and Pepsi but I actually couldn't. The sample table above shows that Tester 1 couldn't tell the difference between the 3 brands but preferred Sam's. Tester 2 correctly named all 3 brands. And Tester 3 could pick out the Sam's brand, but couldn't tell which one was Coke and which one was Pepsi.

The results were as I expected. Only 5 out of 25 people (20%) were able to taste the difference and correctly name all three. 19 of 25 (76%) were unable to correctly distinguish between Coke and Pepsi, but were able to tell which one was Sam's. And 1 person (4%) couldn't tell the difference between any of them. 80% (20 of 25) said that Pepsi tasted the best.

-- E.F.

Chocolate Lovers Unite!



Abstract

An experiment was done to test which of three brands of milk chocolate tasted the best. The three brands were Hershey's, Lindt and Dove. Males and females of widely different ages were involved in the testing process. In the end, the chocolate proven to be the best tasting was Lindt. Dove was a second best and Hershey's the least favorite of the three.

Discussion

Twelve people were involved in the experiment, 6 males and 6 females ranging in ages from 9 to 54. The same amount of each kind of chocolate was fed to each tester and a rating system was used to keep track of the favorite, second favorite and least favorite tasting chocolate, with the overall results as stated above.

From this rating system, there was a pattern among the younger people with ages below 25. Of the 6 testers in that age group, 4 of them chose Hershey's as their favorite. Of the remaining testers above 25 years of age, the favorite chocolate was Lindt with a unanimous result. This trend suggests that younger people like Hershey's best while older people like Lindt.

However, my initial question of a favorite among females being different from that of males could not be answered. An equal number of both males and females chose Lindt as their favorite chocolate. No evidence for a difference between males and females appeared in the sample for this specific experiment.

Future Studies

For further extensions of this study, more testers could be used with a larger variety of age groups. The same number of males and females could be included if one wanted to see if the same results would occur as from this experiment.

-- K. P.

Fuel consumption of my car

The manufacturer of my BMW 328i claims that the car can achieve 21 miles per gallon in city driving and 30 miles per gallon highway driving. I just purchased this vehicle and am very interested in the gasoline mileage the car can achieve on the highway and as the average mpg due to my regular driving.

The research was done with the car on recorded trips. The distance traveled was compared to the amount of gas needed to refill the tank. Refilling the tank to a full state ensures an accurate reading of the amount of gas used. The trip odometer was recorded and reset when the tank is refilled. The amount of gas that was needed to refill the tank is divided into the number of miles traveled to calculate the mpg of the vehicle.

The first recorded trip was from Endicott, NY, to Greene, NY, traveling northbound on route 12. After picking up my children we proceeded to Easton, PA. This trip of town and highway driving consisted of 213.7 miles. When I reached Easton, PA I refilled the gas tank. The tank needed 7.95 gallons of gas to refill the tank. This was an average of 26.9 miles per gallon. On the dash in my car is a digital gauge that displays the average MPG. The gauge said the average MPG of the trip was 26.7 MPG. This was a percent difference of .7% between the calculated value and the digital gage.

The next recorded trip was from Easton, PA to Jackson, NJ, and back to Easton, PA. The trip took 227.6 miles and 8.2 gallons of gas. This trip was purely highway with only about 10 miles being city or town driving. The calculated average was 27.7 MPG and the digital gauge said 27.6 MPG. This resulted in a .3% difference between the calculated value and the digital gage. The manufactures estimated gas mileage for highway driving was 7% higher than the actual result.

Two more trips were recorded, one consisting of city and highway and another of just highway. The results were very similar for the city and highway with an average MPG of 26.3. The highway trip was much better this time with an average of 31.3 MPG. I believe the increase in mileage was due to a slower average speed. I traveled at an average of 10MPH less on the return trip to Endicott, NY form Easton, PA.

I am generally pleased with the results of the test. The mixed-driving mileage of city and highway I am very pleased with. Most of my traveling is of this nature and the average was better than what I expected. I will try to find the most economical highway speed through more trials. I feel highway mileage can be improved with a change in driving technique.

-- J.G.